Membrane wall element for the erection of a tent or hall construction

The invention relates to a membrane wall element for erecting a tent or hall construction, having a wall membrane which is fixed at at least two end sections facing each other.

Humanitarian aid organisations and army units often take part in various missions which require the short-term erection of provisional accommodations to house people. In this context, solutions based on the use of tents are usually employed, but also container solutions were tried. In terms of economic and transport considerations, the tent option has proven to be the most convenient solution, however, as it poses problems associated with its thermal properties, there is a widespread interest in improving these properties in order to reduce thermal signals and save energy under cold and warm climatic conditions.

While it is known from other applications to use air as an insulating medium, it has so far not been employed for conventional tent or hall constructions.

Some more or less permanent hall constructions using tent canvas are already known where the halls are kept upright by air, among others, which is provided in an overpressurised state between the fabric sheets. Such a solution, however, would not be suitable for the above-mentioned tent or hall constructions, as it requires, among others, much additional equipment which furthermore would have to be operated in a safe and stable manner.

EP 1 273 743 A describes a tent having a pneumatic wall construction with a two-layered wall structure comprised of three flexible tent sheets. The inner layer, which is confined by the inner and intermediate tent sheets, is inflatable and forms the main support structure of the wall construction, while the outer layer, which is confined by the intermediate and outer tent sheets, makes up a convection room through which ambient air can pass in ascending direction. Further, inflatable support hoses are present between the intermediate and the outer tent sheets, serving as additional

support structures and spacers. Such a tent, however, due to the continuous pressurisation required, is cost and effort demanding und cannot be operated without power supply via a mains connection or a generator.

It is therefore an aim of the invention to provide a wall element of the initially mentioned-type which offers good thermal properties and is nonetheless constructed in a simple manner, requiring no pressurisation. A further object of the invention is to provide a wall element which is gas and liquid proof while providing high thermal insulation.

According to the invention, this is achieved by providing at least two wall membranes which in their fixed state are spaced apart from one another by at least one rigid spacer element so as to form a cavity between the at least two wall membranes.

Due to the tension acting on the wall membranes, the at least one spacer element adjusts itself in such a way that the wall membranes are kept spaced apart, thereby forming a thermally insulating air cushion.

The at least two wall membranes can be made of tent canvas or of any other suitable material.

A stable fixation of the wall membranes can be achieved by securing the at least two wall membranes at two end sections facing each other within clamping devices, preferably formed by section bars having high stiffness at low weight which may at the same time have grooves adapted for fixing the wall membranes.

In order to fix the at least two wall membranes together as evenly as possible, it has proven advantageous to join the at least two wall membranes at their respective end sections that face each other.

To do so, a known and reliable fixing aid may be employed by providing a keder rope edgewise at the joined end sections of the wall membranes with which the fixation of the wall membranes can be carried out.

Accordingly, the section bars may contain undercut longitudinal channels through which the keder ropes of the joined wall membranes can be pulled in. Therefore, during fixation, the wall membranes can be secured in the section bars along their end sections provided for fixation and prevented from slipping out.

According to a further embodiment of the invention, in order to avoid the labour-intensive pulling-in of keder ropes, the section bars may be formed with longitudinal channels into which the keder ropes of the joined wall membranes can be placed, and the longitudinal channels may be coverable by cover strips so as to secure the keder ropes within the section bars.

As one possible stretching means for stretching the wall membranes, a stretching device having stretcher rods may be provided between the section bars, via which the wall membranes, secured in the section bars, may be stretched apart. Forces exerted onto the stretcher rods by the stretching device move the section bars in such a way that the wall membranes fixed within the section bars are brought into a stretched position.

A possible further development of the invention may consist in the stretching device being actuatable by a toggle lever device whose drive spindle for actuating two toggle levers is oriented transversally to the longitudinal axis of the stretcher rods. Rotating the drive spindle using a suitable tool triggers a stretching movement of the stretcher rods, leading to the wall membranes being put up and therefore bringing about an increased distance between them as the spacer element is brought into its spacing-providing position.

A further embodiment of the invention may consist in having stretcher rods with hollow sections by which they are slidable over profile ends of said toggle lever

device, so that the stretcher rods are movable via toggle-lever actuated displacement elements, while the other end of each stretcher rod has a flange piece for securing to said section bars attached to it. In this way, relatively strong forces for putting up the wall membranes can be generated using the toggle lever device, thereby allowing to bring and maintain even bigger inventive membrane wall elements into their stretched states.

A uniform spacing of wall membranes is achievable if the longitudinal sides of the at least one rigid spacer element extend between the at least two wall membranes in parallel with the joining lines, that face each other, of the wall membranes.

A possible variation of the invention may comprise the rigid spacer element having a rigid connecting piece with flexible strips formed onto its longitudinal sides that are connected with the inside faces, that face each other, of said at least two wall membranes, so that the longitudinal sides of the at least one rigid connecting piece are articulately connected to the wall membranes, with the pivot points on the wall membranes all being spaced equally from the edges of the end sections of the wall membranes, and with the rigid connecting piece and the membrane portions that extend to the end sections forming an isosceles triangle in their stretched state when viewed in cross-section.

Such connecting pieces, if mounted between two wall membranes at end regions that face each other, enable the storage of the non-stretched wall membranes without any spacing in between. As soon as the wall membranes are brought into their stretched state, forces acting on the rigid connecting pieces cause them to orient themselves transversally to the wall membranes, thereby guaranteeing their spacing and the formation of an air cavity there between.

Thus, said at least one rigid connecting piece may further be provided with sufficient stiffness to successfully separate the spaced-apart wall membranes when the wall membranes are fixed.

In terms of functionality, the rigid connecting piece will be realised in the shape of a rod, however, any other spacing-providing embodiment may be chosen within the framework of the invention.

In order to make use of tensile forces, that act on the membranes that face each other, for orienting the rigid connecting piece transversally relative to the membranes as soon as a tensile force is applied onto them, the flexible strips are attached in a way as to extend away from the longitudinal sides of the rigid connecting piece in opposing directions.

In principle, the framework of the invention allows to combine two or more wall membranes, and an embodiment of the invention that is simple to construct consists in that two wall membranes are formed which in their stretched states can be held spaced apart from one another by means of two spacer elements.

Sealing of the inventive wall elements can be obtained if the wall membranes are connected in a sealed manner with each other at those parts that extend along all membrane end regions , and with providing, if necessary, venting devices in order to allow air to enter the cavities when the wall element is being put up.

A wall element according to invention having three wall membranes can be formed by providing an inner wall membrane and an outer wall membrane with a intermediate wall membrane extending in between; the inner wall membrane, the outer wall membrane and the intermediate wall membrane in their fixed state being spaced apart by at least two rigid spacer elements in such a way that cavities will form between them.

The spacing of such a wall element having three wall membranes is more complicated than that of the wall element formed by two wall membranes. One possible embodiment is to have the rigid spacer elements formed with rigid connecting pieces having flexible strips formed onto their longitudinal sides that are connected with the inside faces, facing each other, of the inner wall membrane and

the intermediate wall membrane as well as of the intermediate wall membrane and the outer wall membrane, so that the longitudinal sides of the rigid connecting pieces are articulately connected to the wall membranes, with the pivot points on the wall membranes being chosen in such a way that the membrane portions of the inner and outer wall membranes that extend to the end sections and the rigid connecting pieces form an isosceles triangle in their stretched state when viewed in cross-section, while the intermediate wall membrane extends continuously planarly along the height line of the isosceles triangle. Therefore, when stretching the three-wall-membranes wall-element, the connecting pieces arranged between the wall membranes adjust themselves in such a way that all three wall elements become evenly spaced apart from one another, thereby forming two separated, adjacent air cavities which allow an even higher thermal insulation than the two-wall-membranes wall-element.

For military purposes, the wall membranes may be made of a material which is tight against war gases and the like.

Further, the intermediate wall membrane may be provided with a coating of aluminium or another suitable material in order to achieve heat reflection and/or shielding against electromagnetic radiation. Also the remaining membranes may be provided with such a coating.

In addition, the wall membranes may be provided in such way as to avoid transparency.

For easy removal of soiling, the inner wall membrane may be made of an easy-to-clean material.

As the rigid spacer element arranged between the at least two wall membranes can be inconvenient during transport, the at least one rigid spacer element may be subdivided once or more times along its length to allow the folding of the wall element.

Further, the invention relates to a tent or hall construction using at least one inventive wall element.

The aim is here to provide a tent or hall construction which is easy to erect and disassemble using simple means and which shows good thermal and sealing properties.

According to the invention, this is achieved by the at least one wall element forming a tunnel-shaped cross section with two side-wall parts und one roof-wall part connecting the side-wall parts.

In this way, the entire tent or hall cross-section is constructed by means of at least two continuously extending wall membrane sheets, rendering possible high thermal insulation and high heat-transfer resistance. Any number of such tunnel-shaped cross sections may be lined up, depending on the intended size of the tent or hall construction to be erected.

According to a further embodiment of the invention, the section bars for fixing the wall membranes may extend along a line bent several times according to the selected tunnel-shaped cross section, starting at a first base point and ending at a second base point spaced apart from the former, and along this course of the section bars, two wall membranes may be fixed with spacer elements in order to form the cavity between the two wall membranes.

Another further development of the invention could consist in that at the bending points of the tunnel cross section, the inner one of the wall membranes is shortened in its longitudinal expansion by having a cut-out lens-shaped opening, with the edges of the opening being connectable with the aid of a velcro-type fastening or being welded together. This prevents bulging of the at least two wall membranes at the sites where the course of the at least two wall membranes changes direction.

It is further possible to provide for two or more subdivisions of the inside wall membrane to facilitate the pulling-in into a keder profile.

Another embodiment of the invention could include a further outer wall membrane being stretched between the section bars along the side-wall parts, forming a rear ventilation space between the further outer wall membrane and the two wall membranes. Unlike the air cavity, which is disposed between the two wall membranes of the inventive wall element and provides for thermal insulation, the rear ventilation space formed in that way is intended for venting air through the space in order to dissipate radiant heat which enters from the outside through the outer wall membrane.

Finally, another variation of the invention could consist in stretching an outer roof-wall membrane spaced from the roof-wall part which then forms, between the roof-wall part and the outer roof-wall membrane, an rear-ventilated air-insulation roof-space. The air-insulation roof-space is also intended to dissipate radiant heat by the convection movements of air present in the air-insulation roof-space and prevent warming-up of the interior of the hall.

Now the invention will be described in detail with reference to the embodiments shown in the accompanying drawings, wherein:

Fig. 1 shows a schematic cross section of an embodiment of the membrane wall element according to the invention in its stretched state;

Fig 2 shows a schematic cross section of the wall element of Fig. 1 in its non-stretched state;

Fig. 3 shows a schematic cross section of another embodiment of the wall element according to the invention in its stretched state;

Fig. 4 shows a schematic cross section of a spacer element for various embodiments of the wall element according to the invention;

Figs. 5 and 6 show side and top views, respectively, of a stretching device used with the embodiments shown in Figs. 9 and 11;

Fig 7 shows a front view of part of an embodiment of the wall element according to the invention having a section bar for fixing wall membranes;

Fig. 8 shows a detail of a further embodiment of a section bar for fixing wall membranes;

Fig. 9 shows a cross section of an embodiment of the tent or hall construction according to the invention;

Fig. 10 shows a side view of another embodiment of the wall element according to the invention; and

Fig. 11 shows an oblique view of another embodiment of the wall element according to the invention.

Fig. 1 shows a membrane wall element for erecting a tent or hall construction having two wall membranes 1A, 1B which are secured within clamping devices 5 at their two end regions that face each other.

The wall membranes 1A, 1B are joined at each of their end sections 40 which face each other and can, for example, be made of tent canvas or any other suitable fabric, such as a plastic material. According to the invention, when in their fixed state, the two wall membranes 1A, 1B are spaced apart by rigid or hardly flexible spacer elements 2 in order to form a cavity 6 in between.

Fig. 4 shows an enlarged view of the spacer element 2 having a rigid, rod-shaped connecting piece 3 whose longitudinal sides have flexible strips 4 formed onto them which are connected within the wall element of Fig. 1 to the inside faces of the two wall membranes 1A, 1B that face each other, so that the longitudinal sides of the rigid connecting piece 3 are articulately connected to the wall membranes 1A, 1B.

The flexible strips can be made of the same material as the wall membranes 1A, 1B or of any other suitable material.

In the embodiment shown in Fig. 1, the pivot points at the wall membranes 1A, 1B are spaced equally from the edges of the end sections of the wall membranes; therefore, the rigid connecting piece 3 and the membrane portions that extend to the end sections form an isosceles triangle in their stretched state when viewed in cross-section. Within the framework of the invention, another way of arranging the spacer elements 2 which produces a spaced-apart relationship of the wall membranes 1A, 1B when in their stretched state is also possible.

Further, in cases where there is a long distance between the clamping elements 5, several spacer elements 2, which may either be formed continuously or intermittently, can be provided spaced about the width of the wall elements, in order to maintain a constant spacing between the wall elements 1A, 1B all along the entire width of the wall elements.

The inventive wall element in Fig. 1 is shown in a state where it is fixed between the two clamping elements 5, whereas in Fig. 2 it is shown in its non-stretched state. If a force is applied onto the clamping elements 5 in the direction of the arrows P, the inventive wall element will be tentered or stretched due the transmission of stretching forces to the wall membranes 1A, 1B, which in turn cause the rigid connecting pieces 3, due to their connection with the wall membranes 1A, 1B, to align themselves transversally to the wall membranes 1A, 1B, thereby bringing about the separation of the wall membranes 1A, 1B. This way, a closed, air-filled cavity 6 is formed between the wall membranes 1A, 1B, provided that the latter are connected appropriately with

each other in sealed manner all along their edges. This cavity 6 provides for the desired insulating layer.

Fig. 3 depicts another embodiment of the inventive wall element in which three wall membranes, namely an inner wall membrane 1A, an outer wall membrane 1B and an intermediate wall membrane 1C, forming cavities 6, are put up, providing an even better heat insulation.

Flexible strips 4 are formed onto each of the longitudinal sides of the rigid connecting pieces 3 and connected with the inside faces, which face each other, of the inner wall membrane and the intermediate wall membrane 1A, 1C as well as of the intermediate wall membrane and the outer wall membrane 1C, 1B, so as to have the longitudinal sides of the total of four rigid connecting pieces 3 articulately connected to the wall membranes 1A, 1B, 1C, with the pivot points on the wall membranes 1A, 1B, 1C being chosen in such a way that the membrane portions of the inner and outer wall membranes 1A, 1B that extend to the end sections and the rigid connecting pieces 3 form an isosceles triangle in their stretched state when viewed in cross-section, while the intermediate wall membrane extends continuously planarly along the height line of the isosceles triangle.

The preferably rod-shaped connecting pieces 3 are made of an adequate rigid or semi-rigid material which ensures that the desired spacing between the wall membranes 1A, 1B, 1C is brought about and kept up when the inventive wall element is put up and kept in this stretched state. Shapes or materials used for the connecting pieces 3 are not limited as long as they serve their intended purpose in the framework of the invention.

The types of membrane wall or canvas materials used are independent from the principle of the invention. The only prerequisite is that they are connectable, such as by bonding, welding, or similar techniques. An example of a membrane wall suitable for the invention is an embodiment in which the outer wall membrane 1B is made of polyurethane which seals for example against war gases and the like, and in which

the inner wall membrane 1A is made of an easy-to-clean material, whereas the intermediate wall membrane 1C is aluminium-coated for heat reflection.

There can also be used a coating which in an adequate way offers sufficient protection from electromagnetic radiation so that the tent or hall construction formed with the inventive wall element will act as a Faraday cage.

The wall membranes may be joined together in a fully sealed way along all of their edges; in this case, however, adequate ventilation devices need to be provided in order to allow air to enter and fill the cavity or cavities when the inventive wall element is put up.

Even if only wall elements comprising two or three wall membranes are shown, it is obviously possible to use more membrane layers with its associated spacer elements without departing from the framework of the invention. It is furthermore possible to mount more than two spacer elements between the wall membranes if this is desired or considered necessary on grounds of stability.

Hall or tent constructions constructed according to the invention may also be heated or provided with a cooling system.

In order to guarantee the even fixation of wall elements, the clamping devices of the embodiment according to the Fig. 7 and 11 are formed by section bars 55, made for example of aluminium, and a keder rope 36 is provided edgewise at the joined end sections 40. Within the framework of the invention, however, fixation can also be done without such a keder rope.

In addition to the double membrane according to the invention which is formed by the wall membranes 1A, 1B, a conventional wall membrane 79 is fixed by the section bars 55 in order to form an inventive wall element.

The section bars 55 have undercut longitudinal channels 30 into which the keder ropes 36, 48 of the joined wall membranes 1A, 1B and 79 are pulled (Fig. 7).

Between the section bars 55, a stretching device 15, shown in detail in Figs. 5 and 6, having stretcher rods 25, 26 is provided, via which the wall membranes 1A, 1B and 79, secured in the section bars 55, are stretched apart.

The stretching device 15 is actuated via a toggle lever device 75 whose drive spindle 16, being actuated by toggle levers 17, 18 supported by joints 9, 10, 11, is oriented transversally to the longitudinal axis of the stretcher rods 25, 26. The drive spindle 16 can be rotated via an actuating element 12, thereby triggering the movement of the displacement elements 38, 39. The stretcher rods 25, 26 have hollow sections by which they are slid over guides 13 of the toggle lever device 75, and can accordingly be moved away from each other by the toggle-lever 17, 18 actuated displacement elements 38, 39 for the purpose of stretching the wall elements.

The other end of each stretcher rod 25, 26 has a flange piece 29 mounted to it in order to be secured to the section bars 55. For this purpose, in the embodiment shown in Fig. 7, screws 49 have their heads retained in the undercut slits of the section bar 55, and the respective flange piece 29 is screwed against the section bar 55 with the aid of nuts.

When stretched, the longitudinal sides of the rigid connecting piece 3 extend in between the two wall membranes 1A, 1B and in parallel with the joining lines 90, that face other, of the wall membranes 1A, 1B (Fig. 11).

As pulling in keder ropes 36 can be tiresome with very long section bars 55, the section bars 55' of the embodiment according to Fig. 8 have longitudinal channels 31 into which the keder ropes 36 of the joined wall membranes are placed and which longitudinal channels 31 are then sealed by cover strips 56 shaped correspondingly so as to secure the keder ropes 36 within the section bars 55'. Here, the cover strips

56 are fixed by screws 57 which are screwed into nuts 58 placed in the section bars 55'.

In the exemplary embodiment according to Fig. 10, the at least one rigid spacer element 2 is subdivided once or more times along its length in order to allow the folding of the wall element. This can also be done with three or more parallel wall membranes.

Fig. 9 shows an embodiment of a tent or hall construction erected by using an inventive wall element wherein the wall element, according to the invention, forms a tunnel-shaped cross section having two side-wall parts 80, 81 and one roof-wall part 90 which connects the side-wall parts. The cross-sectional shape can be changed as needed; by lining up more wall elements of the type shown in Fig. 9 to form a tent or hall construction, its longitudinal expansion is virtually unlimited. Also at the ends, inventive wall elements may be attached.

The section bars 55 (not show in Fig. 9) for fixing the wall membranes 1A, 1B extend according to the selected cross section along a line bent several times, starting at a first base point 101 and ending at a second base 102 point spaced apart from the former. Along this course of the section bars 55, two wall membranes 1A, 1B are fixed with spacer elements 2 (not shown in Fig. 9) in order to form the cavity 6 (not shown in Fig. 9) between the two wall membranes 1A, 1B. The entire tunnel profile is thus lined with the double membrane 1A, 1B.

At the bending points of the tunnel cross section, the inner ones of the two wall membranes 1A, 1B are shortened in their longitudinal expansion by having a cut-out lens-shaped opening, and the edges of the opening can be connected with the aid of a velcro-type fastening 130 or welded together. Furthermore, the inner wall membrane may for example be subdivided two or three times, for example into two side-wall parts and one cover-wall part, in order to facilitate the pulling-in into the keder profile.

Along the side-wall parts 80, 81, a further outer wall membrane 79 is stretched between the section bars 55, forming a rear ventilation space between the further outer wall membrane 79 and the two wall membranes 1A, 1B. In the rear ventilation space 95, air can freely circulate in order to dissipate radiant heat, for example due to direct sunlight exposure, which enters through the outer wall membrane 79.

Spaced from the roof-wall part 90, an outer roof-wall membrane 99 is stretched which then forms, between the roof-wall part 90 and the outer roof-wall membrane 99, a rear-ventilated air-insulation roof-space 120. At summer temperatures, the air-insulation roof-space too serves as a cooling means in order to prevent too high temperatures inside the tent construction when it is directly irradiated by sun beams.

The clamping devices 15 shown in Fig. 9 put the wall membranes 1A, 1B and 79 as well as the outer roof wall membrane up.